

## Aufgabe 3.23

**3.23.** Zerlegen Sie die Übertragungsfunktion  $G$ :

$$G(s) = \frac{(s+1)(s-2)(s-3)}{(s^2+2s+2)(s+5)} = G_A(s)G_M(s)$$

so in zwei Faktoren, dass  $G_A$  die Übertragungsfunktion eines Allpasses und  $G_M$  die Übertragungsfunktion eines Mindestphasensystems ist!

## Lösung 3.23: aus der Vorlesung

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2. Zeitkontinuierliche Systeme

Wintersemester 2019/20

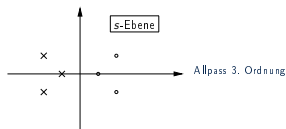
3.13 Systemeigenschaften und  
Klassifizierung

## Allpass und Mindestphasensystem

## Definition

Ein zeitkontinuierliches System mit der Eigenschaft  
 $|G(j\omega)| = 1$  ( $\omega \in \mathbb{R}$ ) heißt Allpass (AP).

Allgemeine Form: ( $f(s)$ : Hurwitz-Polynom)  $G(s) = \frac{f(-s)}{f(s)}$



PN-Plan: Pole und Nullstellen spiegelbildlich zur imaginären Achse



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## Lösung 3.23: aus der Vorlesung

2. Zeitkontinuierliche Systeme

Wintersemester 2019/20

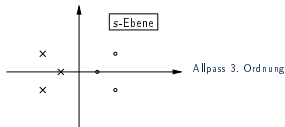
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## Allpass und Mindestphasensystem

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2. Zeitkontinuierliche Systeme

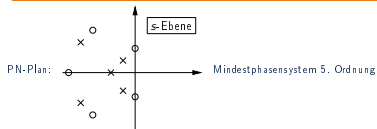
Wintersemester 2019/20

3.13 Systemeigenschaften und  
Klassifizierung

## Mindestphasensystem

## Definition

Ein stabiles System, dessen Übertragungsfunktion  $G$  keine Nullstelle  $s_i$  mit  $\text{Re}(s_i) > 0$  hat, heißt *Mindestphasensystem* (MPS).



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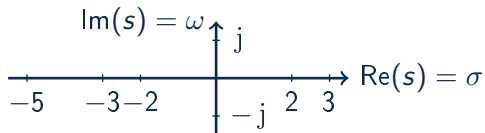
# Lösung 3.23

## Lösung 3.23

$$G(s) = \frac{(s+1)(s-2)(s-3)}{(s^2+2s+2)(s+5)}$$

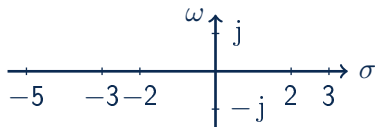
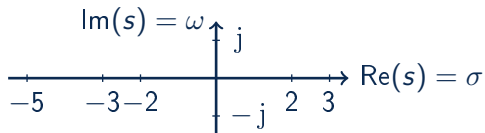
## Lösung 3.23

$$G(s) = \frac{(s+1)(s-2)(s-3)}{(s^2+2s+2)(s+5)}$$



## Lösung 3.23

$$G(s) = G_A(s) = \frac{(s+1)(s-2)(s-3)}{(s^2+2s+2)(s+5)}$$



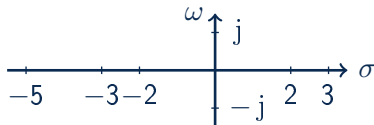
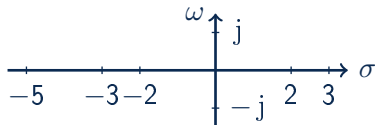
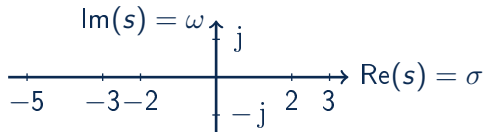
$$G_A(s) =$$

$\underbrace{\hspace{10em}}$   
 Allpass



## Lösung 3.23

$$G(s) = G_A(s) \cdot G_M(s) = \frac{(s+1)(s-2)(s-3)}{(s^2+2s+2)(s+5)}$$



$$G_A(s) =$$

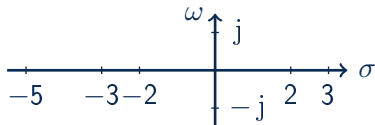
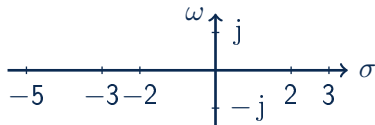
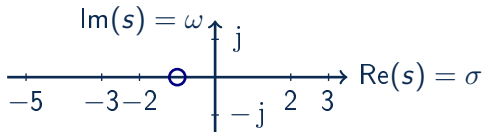
⏟  
Allpass

$$G_M(s) =$$

⏟  
Mindestphasensystem

## Lösung 3.23

$$G(s) = G_A(s) \cdot G_M(s) = \frac{(s+1)}{\quad}$$



$$G_A(s) =$$

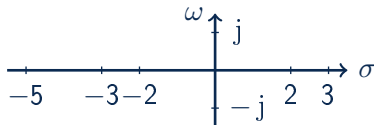
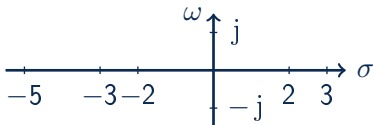
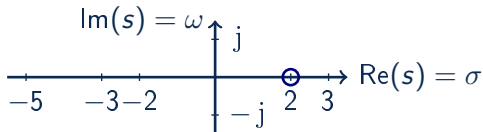
⏟  
Allpass

$$G_M(s) =$$

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Mindestphasensystem

## Lösung 3.23

$$G(s) = G_A(s) \cdot G_M(s) = \frac{(s - 2)}{\quad}$$



$$G_A(s) =$$

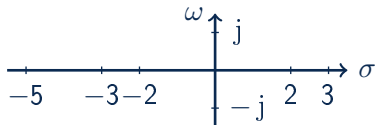
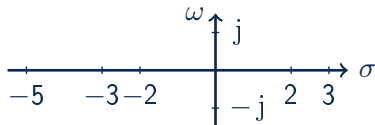
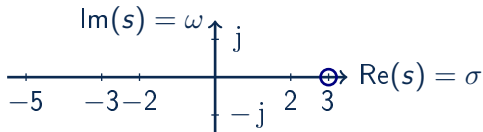
⏟  
Allpass

$$G_M(s) =$$

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Mindestphasensystem

## Lösung 3.23

$$G(s) = G_A(s) \cdot G_M(s) = \frac{\quad}{(s - 3)}$$



$$G_A(s) =$$

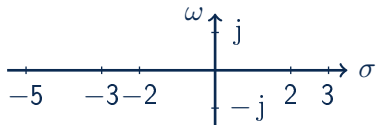
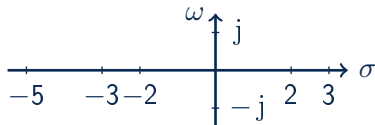
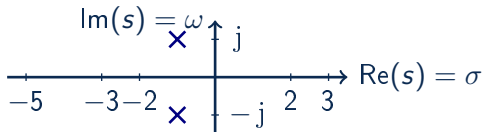
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Allpass

$$G_M(s) =$$

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Mindestphasensystem

## Lösung 3.23

$$G(s) = G_A(s) \cdot G_M(s) = \frac{\quad}{(s^2 + 2s + 2)}$$



$$G_A(s) =$$

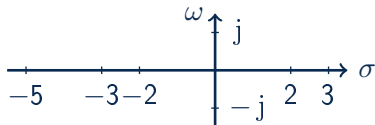
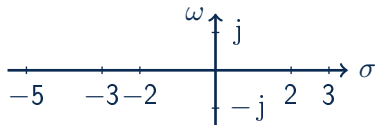
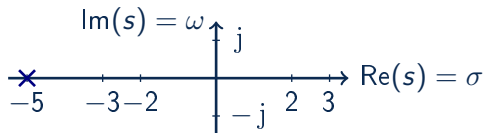
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Allpass

$$G_M(s) =$$

⏟  
Mindestphasensystem

## Lösung 3.23

$$G(s) = G_A(s) \cdot G_M(s) = \frac{\quad}{(s + 5)}$$



$$G_A(s) =$$

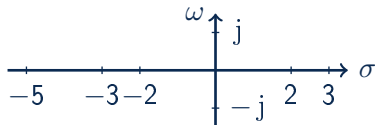
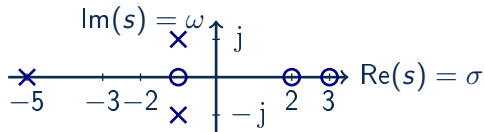
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Allpass

$$G_M(s) =$$

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Mindestphasensystem

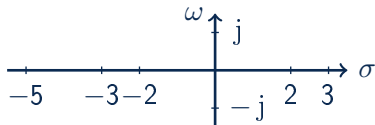
## Lösung 3.23

$$G(s) = G_A(s) \cdot G_M(s) = \frac{(s+1)(s-2)(s-3)}{(s^2+2s+2)(s+5)}$$



$$G_A(s) =$$

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Allpass

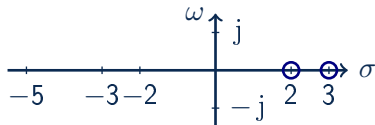
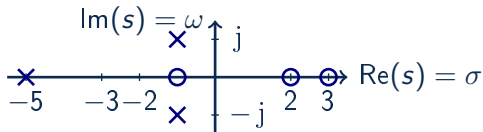


$$G_M(s) =$$

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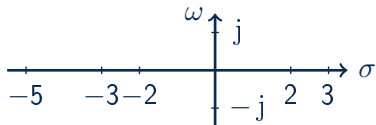
## Lösung 3.23

$$G(s) = G_A(s) \cdot G_M(s) = \frac{(s+1)(s-2)(s-3)}{(s^2+2s+2)(s+5)}$$



$$G_A(s) = \frac{(s-2)(s-3)}{1}$$

Allpass



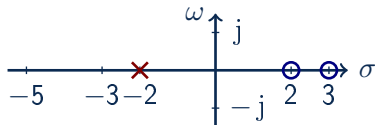
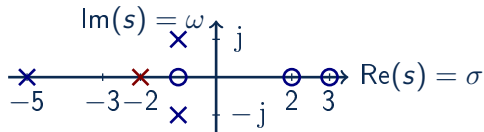
$$G_M(s) = \frac{1}{(s^2+2s+2)(s+5)}$$

Mindestphasensystem



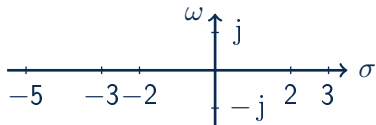
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$$G(s) = G_A(s) \cdot G_M(s) = \frac{(s+1)(s-2)(s-3)}{(s^2+2s+2)(s+5)} \cdot \frac{1}{(s+2)}$$



$$G_A(s) = \frac{(s-2)(s-3)}{(s+2)}$$

Allpass

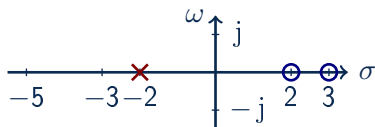
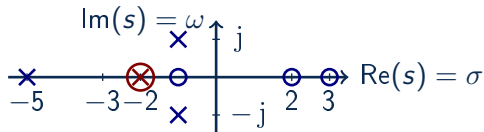


$$G_M(s) =$$

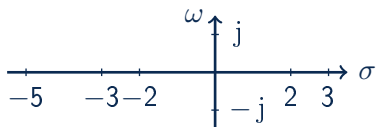
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$$G_A(s) = \underbrace{\frac{(s-2)(s-3)}{(s+2)}}_{\text{Allpass}}$$

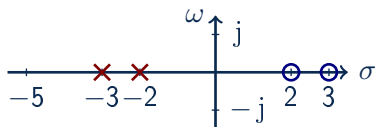
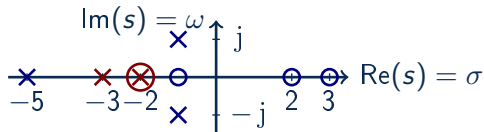


$$G_M(s) =$$

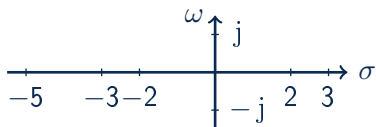
Mindestphasensystem

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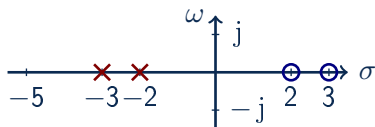
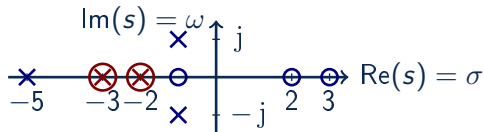


$$G_M(s) =$$

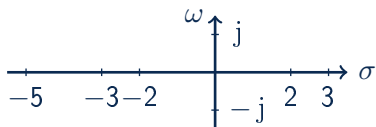
Mindestphasensystem

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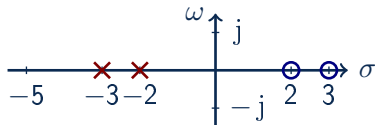
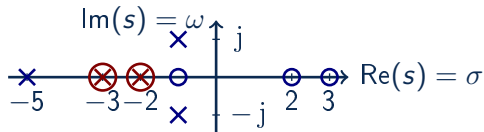


$$G_M(s) =$$

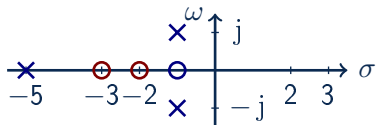
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$$G_A(s) = \underbrace{\frac{(s-2)(s-3)}{(s+2)(s+3)}}_{\text{Allpass}}$$

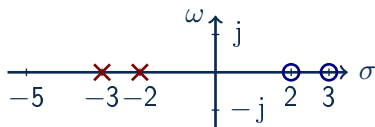
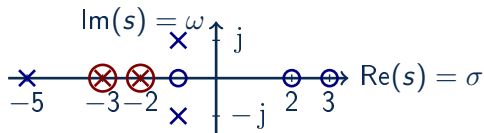


$$G_M(s) =$$

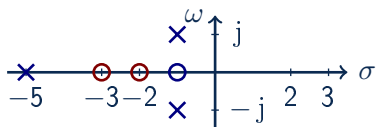
Mindestphasensystem

## Lösung 3.23

$$G(s) = G_A(s) \cdot G_M(s) = \frac{(s+1)(s-2)(s-3)}{(s^2+2s+2)(s+5)} \cdot \frac{(s+2)(s+3)}{(s+2)(s+3)}$$



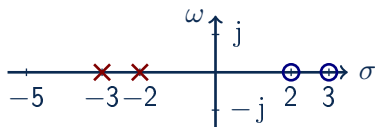
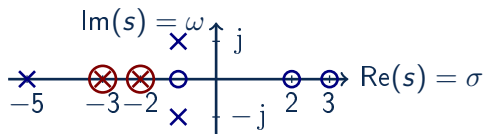
$$G_A(s) = \underbrace{\frac{(s-2)(s-3)}{(s+2)(s+3)}}_{\text{Allpass}}$$



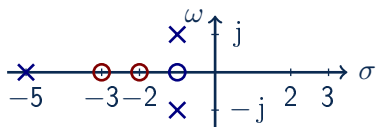
$$G_M(s) = \underbrace{\frac{(s+1)(s+2)(s+3)}{(s+2)(s+3)}}_{\text{Mindestphasensystem}}$$

## Lösung 3.23

$$G(s) = G_A(s) \cdot G_M(s) = \frac{(s+1)(s-2)(s-3)}{(s^2+2s+2)(s+5)} \cdot \frac{(s+2)(s+3)}{(s+2)(s+3)}$$



$$G_A(s) = \underbrace{\frac{(s-2)(s-3)}{(s+2)(s+3)}}_{\text{Allpass}}$$



$$G_M(s) = \underbrace{\frac{(s+1)(s+2)(s+3)}{(s^2+2s+2)(s+5)}}_{\text{Mindestphasensystem}}$$